RAMP METERING

PROCEDURE MANUAL ADDENDUM

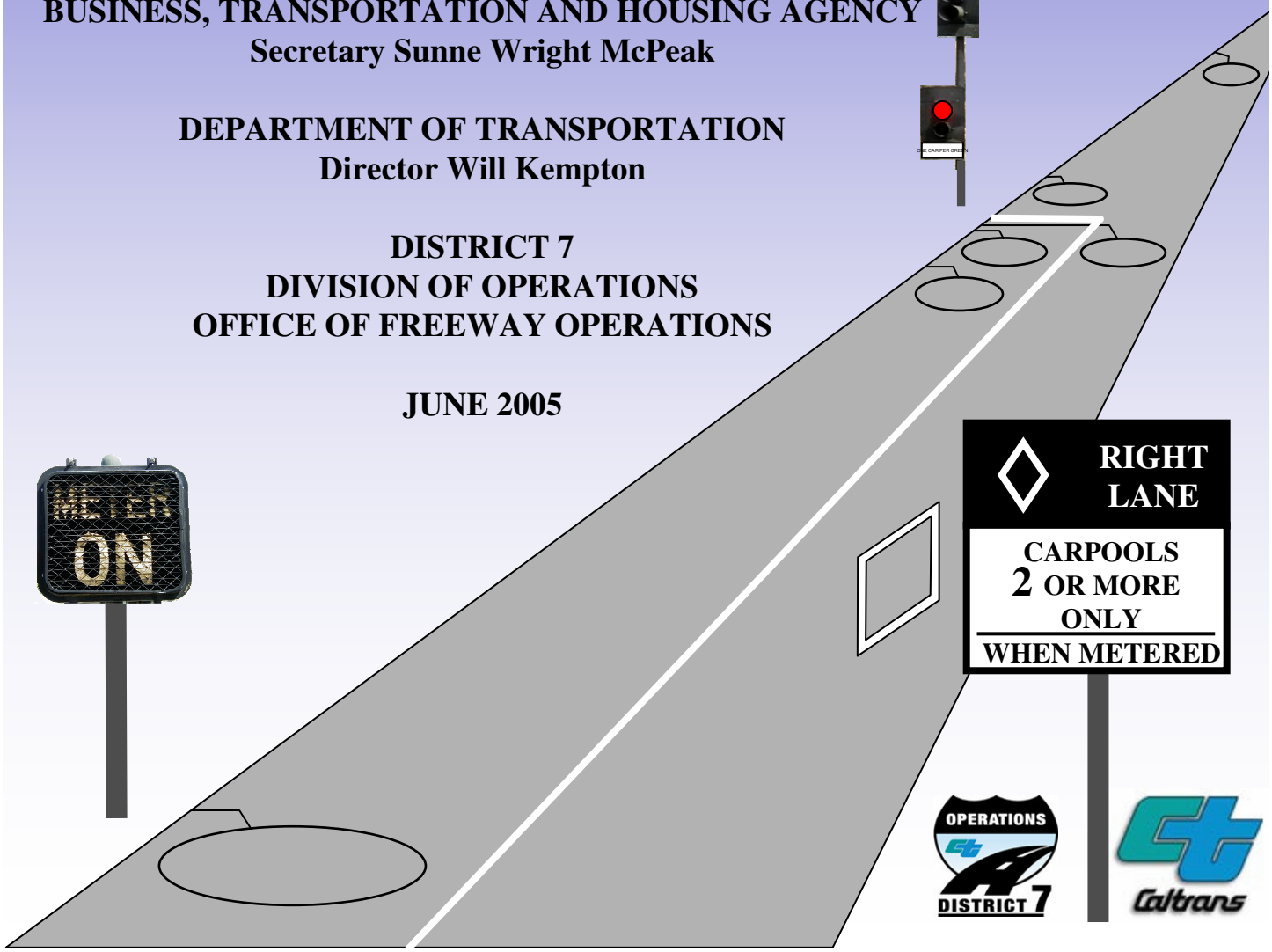
STATE OF CALIFORNIA
Governor Arnold Schwarzenegger

BUSINESS, TRANSPORTATION AND HOUSING AGENCY
Secretary Sunne Wright McPeak

DEPARTMENT OF TRANSPORTATION
Director Will Kempton

DISTRICT 7
DIVISION OF OPERATIONS
OFFICE OF FREEWAY OPERATIONS

JUNE 2005



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BUSINESS, TRANSPORTATION AND HOUSING AGENCY
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DISTRICT 7
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RAMP METERING

P R O C E D U R E
M A N U A L
ADDENDUM

DEPARTMENT OF TRANSPORTATION

DISTRICT 7

DOUG FAILING
DISTRICT DIRECTOR

FRANK QUON
DEPUTY DISTRICT DIRECTOR OF OPERATIONS

MARCO RUANO
OFFICE CHIEF, OFFICE OF FREEWAY OPERATIONS

AFSANEH RAZAVI
BRANCH CHIEF, RAMP METERING BRANCH

JUNE 2005

FOREWORD

Enclosed is an Addendum to District 7 RAMP METERING PROCEDURE MANUAL (RMPM) of 2002. This document was prepared to update ATTACHMENT A and APPENDIX B, which describes the latest SATMS* ramp metering software.

In 2002, when the RMPM was issued, the SATMS software was under development (interim version) and was known as SATMS 2.3. The latest and final version is SATMS 3, which is included in this Addendum.

*** SATMS** is an acronym for **S**emi **A**utomatic **T**raffic **M**anagement **S**ystem

ATTACHMENT A

- **RAM MAP**
  (Page "00XY" & TOD Table)
- **LOOP DETECTOR SENSOR LAYOUT SHEET**
- **AS-BUILTS PLAN**

Notes:

- Ramp Metering personnel are **responsible** for the creation, placement and up-keep of these documents (RAM MAP, Loop Detector Sensor Layout Sheet and As-Built plans).

- These documents **must be placed inside every** RMS and VDS cabinet in the District.

SATMS 3.0 RAM Page 0

Date 1/18/2007

Route	105	**Direction**	WB	**P.M.**	R3.30	**Location**	PRAIRIE / IMPERIAL HWY
E. No	E4808	**Loc. No.**	1808	**Line No.**	33	**Controller No.**	3	**Engineer**	RAFAEL BENITEZ

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		"BITS" or "FLAGS"
0	GETADD		DATA	CHARCT	SCTML1	TEMP00	CYLEN	RXSTST	CONT ID 03	FMNL 255	HOLTBL 00	CFTRR	TBCNT2	DATA0A	DATA1A	STATUS	0	
1	"+1"		BLKOUT	SPCOUT	SCTML2	TEMP01	DCNTR	TXSTAT	FIRGR 60.0	FLSHR 00		Q1CYTMR	ACKFLG	DATA0B	DATA1B	SIGMSK 0 0	1	
2	PUTADD		PGADD	MODE	SCTML3	TEMP02	PCNTR	TXINIT	PLTYEL 0.0	LASTGR 60			ETBFLG	DATA0C	DATA1C	QFLAG	2	
3	"+1"		WDADD	CHARIN	SCTML4	TEMP03	YCNTR	INCTR	LNGYEL 3.0	PHYSML 03		GOODML	PADFLG	DATA0D	DATA1D	QSTAT	3	
4	EXINDX		D1	LASTCB	SCTML5	TEMP04	DLETM	BTCK		PHYSOP 00		GOODOS	CARCT1	DETINA	STCHGA	COMM1 0 F	4	1 2 3 4
5	"+1"		D2	TIMEFX	SCTML6	TEMP05	PLETM	TRCODE	QTHRS 2.0	Q2THRS 0.0		RLPSEL	SPRCNT	DETINB	STCHGB	COMM2 0 4	5	3
6	HZ30		D3	HR	SCTOS1	TEMP06	GRNTMR	CCHK	MXGRNA 5.0	QON 0.0		MAXRATE	ACKMEM	DETINC	STCHGC	DTCTRA 4 7	6	1 2 3 7
7	HZ30+1		D4	MIN	SCTOS2	TEMP07	QTMR	XCCHK	MXGRNB 0.0	Q2ON 0.0		QMAXRAT	"+1"	DETIND	STCHGD	DTCTRB 0 0	7	
8	HZ30+2		D5	SEC	SCTOS3	TEMP08	CNTR	GRFLAG	CROCCA 15.0	QOFF 0.0			ENDFG1	BLKTMR	ERRORA 00	DTCTRC 3 F	8	1 2 3 4 5 6
9	HZ30+3		D6	YEAR	SCTOS4	TEMP09	TIME	RBPNTR	CROCCB 0.0	Q2OFF 0.0			ENDFG2	GRNFLG	ERRORB	DTCTRD 1 1	9	1 5
A	HZ30+4		H1	MONTH	SCTOS5	TEMP0A	SOURCE	"+1"	CRVOLA 90				XMITFG	EXFLAG	ERRORC	ALTDES	A	
B	HZ30+5		H2	DAOFMO	SCTOS6	TEMP0B	RATE	TBPNT1	CRVOLB 00	MINGRN 2.0			SEND1	TXFLGS	ERRORD	LNDSML 0 0	B	
C	TMFLAG		H3	DAOFWK	DWNCNT	BITSTR	MXGRN	"+1"	PSELA 01	CRSPEED 35			TSTFLG		ERSETA	LNDSOS 0 0	C	
D	BFTMR		H4	DIM	TLANES	CYCLY	PSEL	TBCNT1	PSELB 00	Q1CYGRN 255				DEFLAG	ERSETB	ENBLR 0F	D	1 2 3 4
E	"+1"		H5	SSEC	LNCNT	PCC	CRVOL	TBPNT2	RLANES 01	Q1MAXSET 15				STSC	ERSETC	SIGFLG	E	
F	MONITR		H6	DAYPTR	WDTGGL	VLTN	CROCC	"+1"	GRNHLD 60	RATESTP 02	00			REFLAG	ERSETD 00	DPERR	F	
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F		

SATMS 3.0 Detector Layout Sheet

Date 1/18/2007

Route	105	Direction	WB	P.M.	R3.30	Location	PRAIRIE / IMPERIAL HWY
E. No.	E4808	Location No.	1808	Line No.	33	Controller No.	3	Engineer	RAFAEL BENITEZ

SLOT #1	SLOT #2	SLOT #3	SLOT #4	SLOT #5	SLOT #6	SLOT #7	SLOT #8	SLOT #9	SLOT #10	SLOT #11	SLOT #12	SLOT #13	SLOT #14
D1 0F8-1 X	SD1 0F9-1 X	Q1 0F8-3 X	HOV 0F8-6 X	ON1 0F8-4 X	SD4 0F9-4	CD ON 0F8-8	CD1 0F8-7	OS1 OF7-1	OS3 OF7-3	OS5 0F7-5	ML5 0F6-5	ML3 0F6-3 X	ML1 0F6-1 X
P1 0F8-2 X	SD2 0F9-2	SD3 0F9-3	Q2 0F9-6	OFF1 0F8-5 X	SD5 0F9-5 X	CD OFF 0F7-8	CD2 0F7-7	OS2 OF7-2	OS4 OF7-4	OS6 0F7-6	ML6 0F6-6	ML4 0F6-4	ML2 0F6-2 X
Descrp	Descrp ML HOV	Descrp		PRAIRIE AVE OFF	HAWTHORNE BL OFF	Descrp	Descrp						
					Descrp HAWTHROFF								

0F1

0 0	1		Enable Device 1
	2		Enable Device 2

0F4

	1	X	Enable Metering
	2	X	Enable Local Responsive
0 F	3	X	Enable Q1 Override
	4	X	Enable Q2 or Super Q1 Overr.
	5		Enable Independent Q2
	6		Chk ML Speed Before Q-overr.
	7		Enable Mag. D & P Lock-in

0D2

0F6

	1	X	Main Line 1
	2	X	Main Line 2
4 7	3	X	Main Line 3
	4		Main Line 4
	5		Main Line 5
	6		Main Line 6
	7	X	ML HOV Flag
	8		Fwy Conn Flag

0D4

0F8

	1	X	Demand
	2	X	Passage
3 F	3	X	Queue 1
	4	X	ON1
	5	X	OFF1
	6	X	Ramp HOV
	7		CD1
	8		CD ON

PRAIRIE OFF

0D6

0FB

	1	ML1 Disabler
	2	ML2 Disabler
0 0	3	ML3 Disabler
	4	ML4 Disabler
	5	ML5 Disabler
	6	ML6 Disabler
	7	(Not Used)
	8	(Not Used)

0F5

	1		Device 1 Flash
	2		Device 2 Flash
0 4	3	X	"Meter On" Sign Flash
	4		Enable Load Switch Monitoring
	5		Pre-time Red (if no Demand Det)
	6		Pre-time Green (if no Passage Det)
	7		Enable Shutdown Top EMS Failure
	8		Enable Shutdown Bot. EMS Failure

0D3

0F7

	1		Opp Side 1
	2		Opp Side 2
0 0	3		Opp Side 3
	4		Opp Side 4
	5		Opp Side 5
	6		Opp Side 6
	7		CD2
	8		CD OFF

0D5

0F9

	1	X	SD1	ML HOV
	2		SD2	
1 1	3		SD3	
	4		SD4	
	5	X	SD5	HAWTHROFF
	6		Queue 2	
	7		Pass Vol Count	
	8		(Not Used)	

0D7

0FC

	1	OS1 Disabler
	2	OS2 Disabler
0 0	3	OS3 Disabler
	4	OS4 Disabler
	5	OS5 Disabler
	6	OS6 Disabler
	7	(Not Used)
	8	(Not Used)

SATMS 3.0 Time-Of-Day Table

Date 1/18/2007

Route	Direction	P.M.	Location
105	WB	R3.30	PRAIRIE / IMPERIAL HWY

E. No.	Location No.	Line No.	Controller No.	Engineer
E4808	1808	33	3	RAFAEL BENITEZ

No. of Metered Lane(s) 1 | **HOV Lane** YES

Platooning Plans

(Column A CLR)

PSELA($8C) = 01 | MAXGRNA ($86) = 5.0

(Column A SET)

PSELB($8D) = 00 | MAXGRNB ($87) = 0.0

Critical Volume/Occupancy Plans

(Column B CLR)

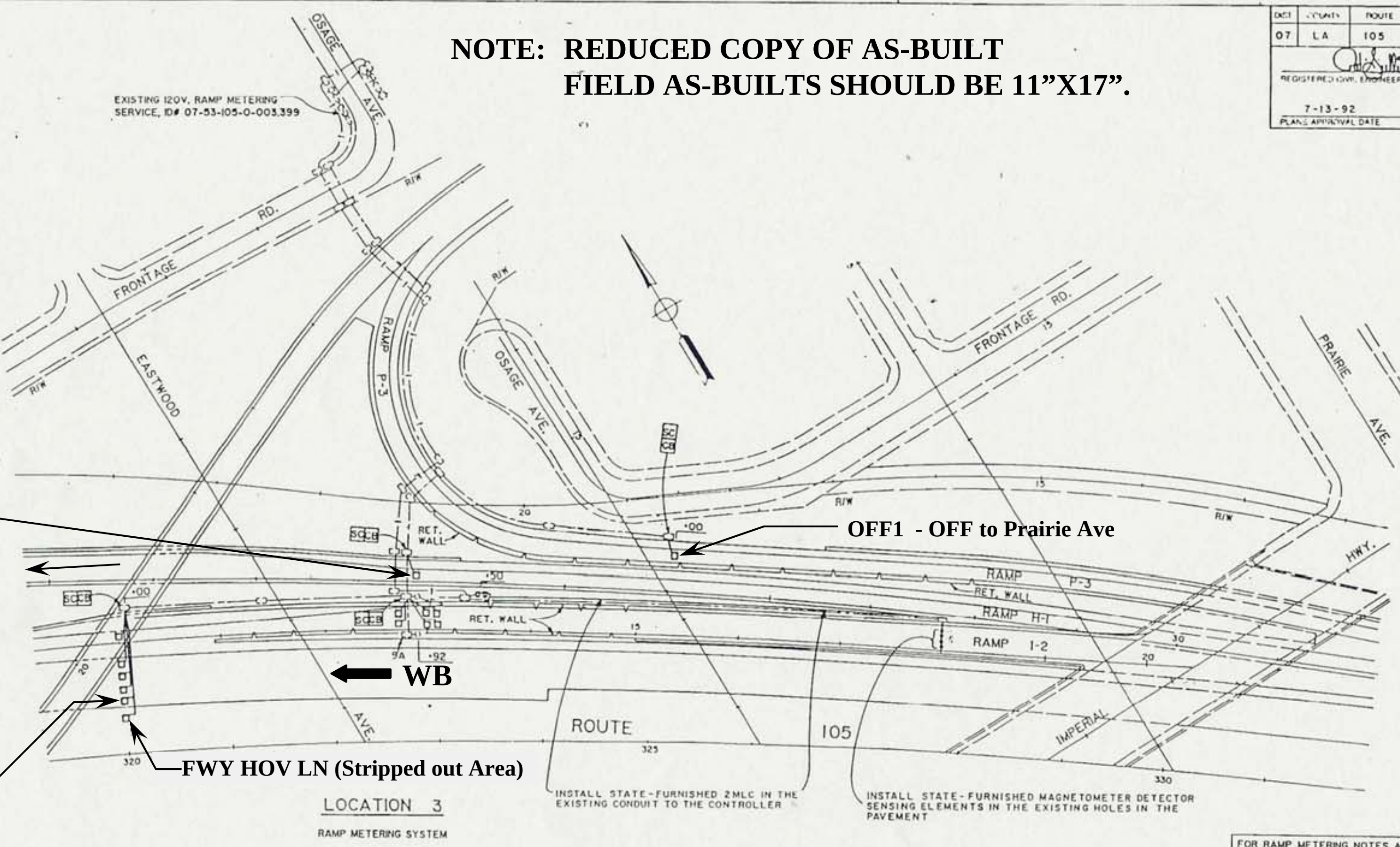
CRVOLA ($8A) = 90 | CROCCA ($88) = 15.0

(Column B SET)

CRVOLB ($8B) = 00 | CROCCB ($89) = 0.0

INTV	Time of Day (Hrs.)	Rates (Veh/Min)	Days of the Week							DEV 1 On	DEV 2 On	(A) Platn	(B) Crvol
			M	T	W	Th	F	Sa	Su				
01	0530	08	X	X	X	X	X						
02	1400	10	X	X	X	X	X						
03	1930	00	X	X	X	X	X						
04	3333												
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													

NOTE: REDUCED COPY OF AS-BUILT
FIELD AS-BUILTS SHOULD BE 11”X17”.



DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO	TOTAL SHEETS
07	LA	105	R2.5/R5.5	58	75

REGISTERED CIVIL ENGINEER

7-13-92
PLANS APPROVAL DATE

FOR RAMP METERING NOTES AND LEGEND SEE SHEET E-8

FOR PROJECT NOTES & LEGEND SEE SHEET E-4

LA-105-WB PM 3.30
AT PRAIRIE/IMPERIAL

FWY OPS
Traffic Engineer: Rafael Benitez
(213) 897-1666

RAMP METERING SYSTEM
(LOCATION 3)
SCALE: 1"=50'
E-3

NOTE: THIS PLAN ACCURATE FOR ELECTRICAL ONLY.

TRAFFIC DESIGN
J. KAMAMOTO

I - 105 CENTURY PROJECT 61 | CU 07202 | EA 115001

APPENDIX B

SATMS 3 SOFTWARE
WORKSHOP NOTES*

***This Appendix is the workshop notes of Mr. Liem Phan, TMC Support.**

SATMS-3 Workshop

April 15-17, 2003

Workshop's Objective

- To understand the differences between the original program SATMS-1 and this new program SATMS-3

SATMS-3
Installation Procedure

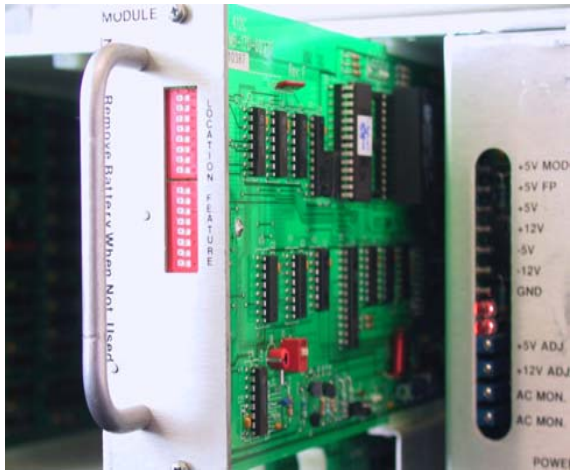
1. Read existing Controller ID which is displayed at address $280
2. Power down the controller
3. Install new chip & set the Controller ID on dip-switch
4. Power up the Controller: Satms-3 will automatically erase all existing memory
5. Verify Software version ($3E0) and Controller ID ($280)
6. Re-enter Controller ID at $080. Push 'E' to confirm your entry.
7. Setup real time clock and calendar
8. Setup T.O.D and Holiday Tables
9. Enter values at column 8, 9, and F
10. RESET Watch Dog

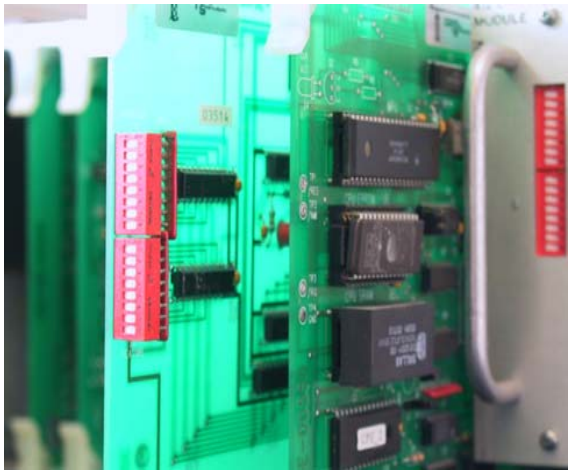
Note: One should use Field Manual ($090) to test proper operation of the controller before leaving

SATMS-3
Controller ID & New Chip

EPROM Board

- New chip 27256 at U1
- Controller ID is set at the DIP switch



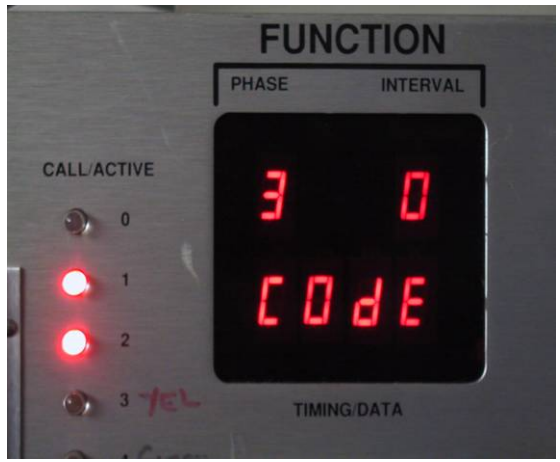


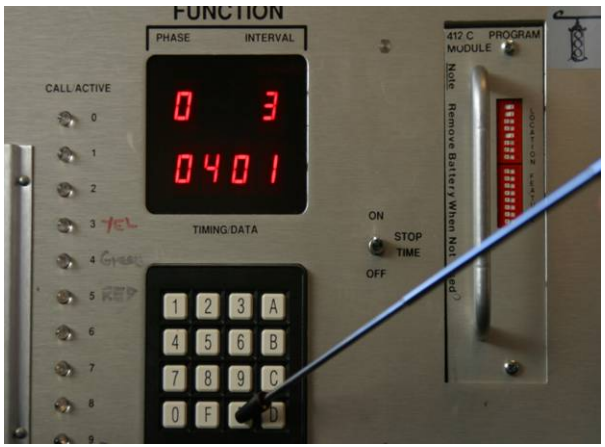
CPU Board & M170/E Board

- The chip 27256 can also be installed on the CPU board
- And the Controller ID is set at the DIP switch on the M/170E board

SATMS-3 Version 3.0
Software Version Identification

- When Power Up the controller, the software version 3.0 is shown for a brief moment
- Software code can also be read at address $3E0





- Each version has a unique released date. SATMS-3 version 3.0 released date is 04-01-03
- To check the date, just press ‘E’

SATMS-3
Controller ID – DIP Switch Settings

Controller Number	DIP Switch Settings	Controller Number	DIP Switch Settings
01	1	11	1, 2, 4
02	2	12	3, 4
03	1, 2	13	1, 3, 4
04	3	14	2, 3, 4
05	1, 3	15	1, 2, 3, 4
06	2, 3	16	5
07	1, 2, 3	17	1, 5
08	4	18	2, 5
09	1, 4	19	1, 2, 5
10	2, 4	20	3, 5

SATMS-3
Controller ID: Verification & Confirmation

- The Controller ID can be verified at address $280

- The same Controller ID must be re-entered at address $080 for confirmation
- If (080) & (280) do not match, you will see the effect of Rolling **Alpha-Numeric**

SATMS-3

Start Up & Shut Down	SATMS-3	Vs	SATMS-1
Automatic Start up Sequence	First Green (safety), Green Long Yellow (safety), and Red		N/A
Automatic Shutdown Sequence	Last Green (safety)		N/A

SATMS-3
Automatic Start Up Sequence

1. Black Ball : Meter is off
2. Green Ball :
   - First Green period: between 60 sec to 255 sec, set at address First Green (FIRGR) $081
   - Green Hold period: if applicable
   - Green period: a few seconds of green time
3. Yellow Ball: duration in one-tenth of a second is set at Long Yellow (LNGYEL) $083
4. Red Ball : waiting for Demand call

SATMS-3
Automatic Shutdown Sequence

1. Color Ball : Meter is Operational
2. Green Ball: duration in second is set at address Last Green (LASTGR) $092
3. Black Ball: Meter is off

SATMS-3

Automatic Startup & Shutdown Simplify T.O.D. Table

T.O.D. Table – in SATMS-1

INTV	Time of Day	Rates	Days of the Week						
	(Hrs.)	**(Veh/Min)**	M	T	W	Th	F	Sa	Su
01	**0500**	**01**	**X**	**X**	**X**	**X**	**X**		
02	**0501**	**10**	**X**	**X**	**X**	**X**	**X**		
03	**1900**	**01**	**X**	**X**	**X**	**X**	**X**		
04	**1901**	**00**	**X**	**X**	**X**	**X**	**X**		
05	**3333**								
06									

SATMS-3
Reduces the Number of Intervals

- 1 minute Green at Start Up is replaced by automatic First Green, maximum 255 second
- 1 minute Green at Shutdown is replaced by automatic Last Green, maximum 255 second

INTV	Time of Day (Hrs.)	Rates (Veh/Min)	Days of the Week						
			M	T	W	Th	F	Sa	Su
01	0500	01	X	X	X	X	X		
02	0501	10	X	X	X	X	X		
03	1900	01	X	X	X	X	X		
04	1901	00	X	X	X	X	X		
05	3333								
06									

SATMS-3

T.O.D. Table – in SATMS-3

INTV	Time of Day (Hrs.)	Rates (Veh/Min)	Days of the Week						
			M	T	W	Th	F	Sa	Su
01	0500	10	X	X	X	X	X		
02	1900	00	X	X	X	X	X		
03	3333								
04									
05									
06									

SATMS-3
Traffic Responsive Enhancements

Traffic Responsive Rate	SATMS-3	Vs	SATMS-1
Maximum Rate	Dependent on number of vehicles/green		Independent on number of vehicles/green
TRRATE	Continuously updating status and rate		N/A
Local Speed display	Yes		N/A
Local Occupancy display	Yes		N/A

SATMS-3
RATE – The Metering Rate

- Definition: Metering rate is a total number of Vehicles Per Minute (VPM) that are allowed entering the freeway

- The Metering Rate is entered into the 170 controller by different ways : 1) Manual input, 2) SWARM, 5) Traffic Responsive, and 6) T.O.D. Table

- Every 30 second, the controller selects one of the available rate in the priorities shown in the Rate Hierarchy table

SATMS-3
Rate Hierarchy

1. Highest Level 1: Field Manual
2. 2nd Level : SWARM rate
3. 3rd : PSO (not used)
4. 4th : CORM (not used)
5. 5th : Traffic Responsive Rate
6. 6th : T.O.D. Rate

SATMS-3

MAXRATE – The Maximum Metering Rate

- Unlike SATMS-1, the maximum rate under SATMS-3 is tailored to the chart on the right (for 1 lane metering)
- For multiple metering lanes, the Maximum Rate is the rate shown in the table multiplied by the number of metered lane
- When the selected rate is more than MAXRATE - displayed at address $0B6 – the meter will go to Rest-in-Green

Cycle length Table

TABLE OF CYCLE LENGTH RELATIVE TO VOLUME OF TRAFFIC

VEH PER GREEN	CYCLE LENGTH (SEC)	RED TIME (SEC)	VEH PER MINUTE	VEH PER 5 MIN.	VEH PER 15 MIN.	VEH PER HOUR (VPH)
1	20.0	18.0	3	15	45	180
1	15.0	13.0	4	20	60	240
1	12.0	10.0	5	25	75	300
1	10.0	8.0	6	30	90	360
1	8.6	6.6	7	35	105	420
1	7.5	5.5	8	40	120	480
1	6.7	4.7	9	45	135	540
1	6.0	4.0	10	50	150	600
1	5.5	3.5	11	55	165	660
1	5.0	3.0	12	60	180	720
1	4.6	2.6	13	65	195	780
1	4.3	2.3	14	70	210	840
1	4.0	2.0	15	75	225	900
2	15.0	11.0	8	40	120	480
2	13.3	9.3	9	45	135	540
2	12.0	8.0	10	50	150	600
2	10.9	6.9	11	55	165	660
2	10.0	6.0	12	60	180	720
2	9.2	5.2	13	65	195	780
2	8.6	4.6	14	70	210	840
2	8.0	4.0	15	75	225	900
2	7.5	3.5	16	80	240	960
2	7.1	3.1	17	85	255	1020
2	6.7	2.7	18	90	270	1080
2	6.3	2.3	19	95	285	1140
2	6.0	2.0	20	100	300	1200
3	13.8	7.8	13	65	195	780
3	12.9	6.9	14	70	210	840
3	12.0	6.0	15	75	225	900
3	11.3	5.3	16	80	240	960
3	10.6	4.6	17	85	255	1020
3	10.0	4.0	18	90	270	1080
3	9.5	3.5	19	95	285	1140
3	9.0	3.0	20	100	300	1200
3	8.6	2.6	21	105	315	1260
3	8.2	2.2	22	110	330	1320
3	7.8	1.8	23	115	345	1380

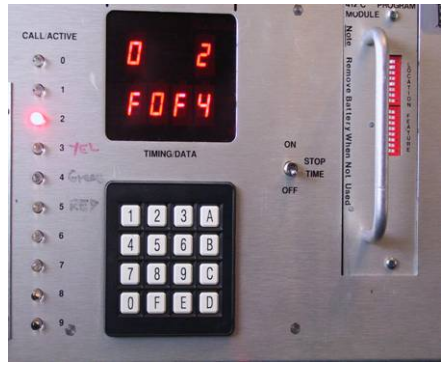
*Assume green time = 2 seconds/veh, yellow time=2.0 seconds

SATMS-3
TODRATE - Time-Of-Day Metering Rate

- This is the lowest-priority rate; Hence, it is the “fall-back” rate
- The program reads TODRATE from the T.O.D. Table

SATMS-3
Traffic Responsive Rate (TRRATE)

1. Enable TRRATE: set bit 2 of $0F4



2. Enter the desired Critical Occupancy at $088

CROCCA

8 8
0 0 0. 0

3. Enter the desired Critical Volume at $08A

CRVOLA

8 A
0 0 0 0

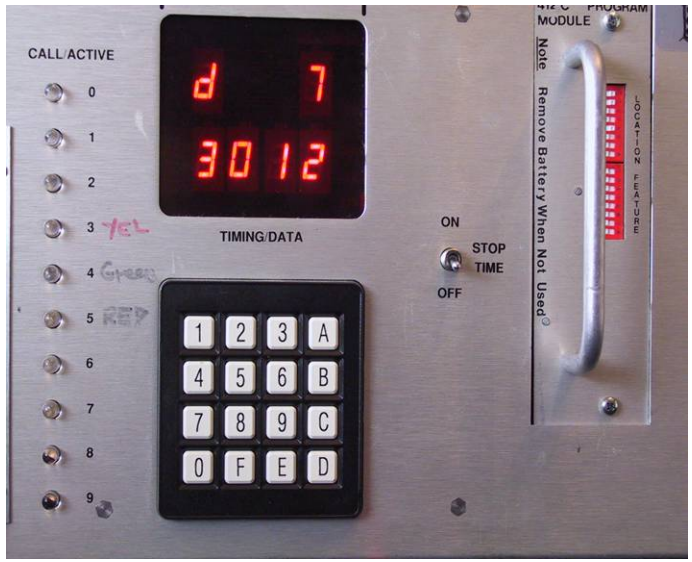
SATMS-3
TRRATE - Traffic Responsive Metering Rate

- When the mainline volume and occupancy are both less than the desired Critical Volume AND Critical Occupancy, the controller recommends its own rate TRRATE

- If TRRATE < TODRATE : Use TODRATE
- If TRRATE > TODRATE : Use TRRATE
- If TRRATE > MAXRATE : Rest-in-Green

SATMS-3
Traffic Responsive Rate (TRRATE)

- With SATMS-3, TRRATE is continuously calculated every 30 seconds, and displayed at address TRRATE $3D7



SATMS-3
Local Speed and Occupancy

- Estimated speed on Mainline, Opposite Side, and HOV Ramp are available:
  - $357 ;Average 3 Min per lane (MPH) on Mainline
  - $358 ;Average 3 Min per lane (MPH) on Opposite Side
  - $359 ;Average 3 Min per lane (MPH) on HOV Ramp

- Estimate Occupancy can also be read (in %):
  - $354 ;Average 1 minute occ mainline in percent (%)
  - $355 ;Average 1 minute occ opposite side (%)
  - $356 ;Average 1 minute occ HOV metering lane (%)

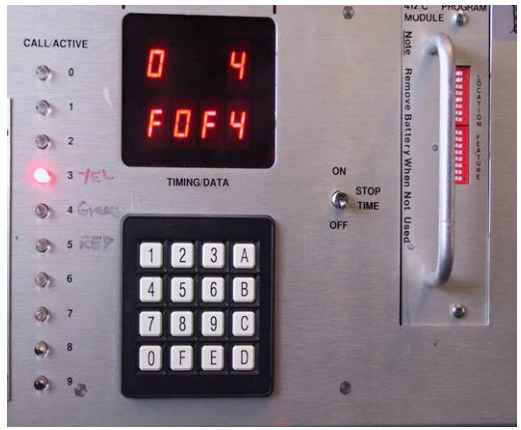
SATMS-3
Queue Override Enhancements

Queue-Overrides	SATMS-3	Vs	SATMS-1
Number of Queue	Q1 and Q2 to handle Connector Metering		Q1 only
Queue 1 activated	Can be set for No Action or gradullay increment to Maximum Queue Rate or go dorectly to Rest-In-Green		Cycle Length = 4 seconds regardless of no. of platoon
Q2 activate	Rest-in-Green		N/A
Freeway priority	Yes (cancel Queue if MainLine Speed is low)		N/A
Surface street priority	Yes (rest-in-green if Queue continuously activated for a long time)		N/A
Queue Rate Priority level	Two levels: higher or lower than SWARM		One level only

SATMS-3 Q1 Override

Gradually raise the existing rate to its maximum

1. Enable Q1, and set Q1-Override level
   - Lower than SWARM, set bit 3 of $0F4



   - Higher than SWARM, set both bit 3 and 4

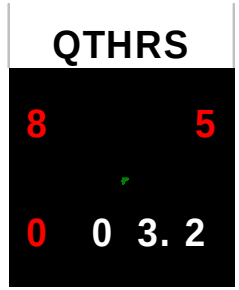
SATMS-3 Q1 Override

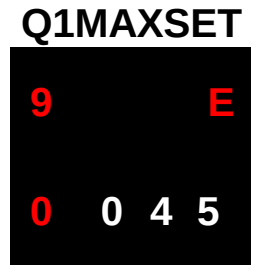
Gradually raise the existing rate to its maximum

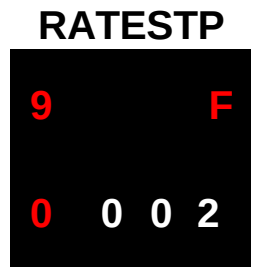
2. Enter Q1 Threshold level at $085

3. Enter the desired maximum Q1 rate at $09E (must be less than or equal to the MAXRATE)

4. Enter the step value called Rate Step or RATESTP $09F



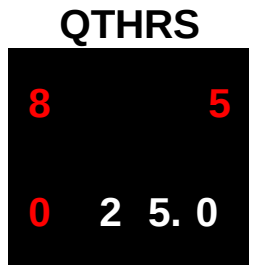




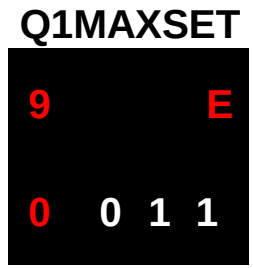
SATMS-3 Q1 Override

Can be set for NO action, or LIMITED action

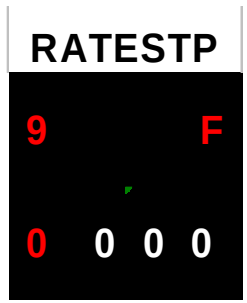
2. Big Threshold Level at $085



3. Small Maximum Q1



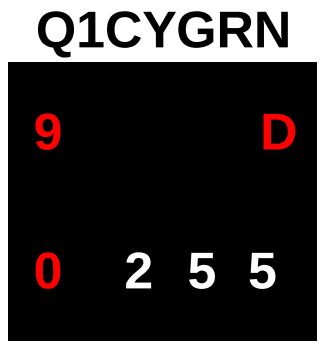
4. Zero Rate Step



SATMS-3 Q1 Override

Can be set for Rest-in-Green

- When Q1 reach its maximum
- And continuously stay at the maximum
- For X number of cycle (each cycle is 30 seconds) set at address $09D



- Q1 goes to Green Ball - Surface Street Priority

SATMS-3 Q2 Override

Rest-in-Green

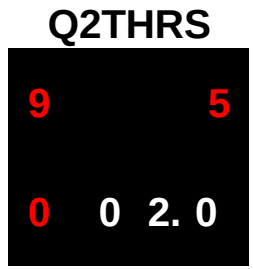
1. Enable Q2, set both bit 3,4 of $0F4

2. For Independent Q2, bit 5 must also be set

SATMS-3 Q2 Override

Rest-in-Green

3. Enter Q2 Threshold level at $095



SATMS-3
Q2 Override, Dependent on Q1

When Q2 is activated, and:

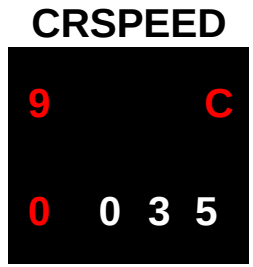
- If Q1 has not been activated: False Q2 activation – No action
- If Q1 is currently ON: Signal goes to Rest-in-Green

SATMS-3
Q2 Override, Independent of Q1

- Don’t care Q1 status
- When Q2 is ON, meter is Rest-in-Green

SATMS-3
Queue Override – Freeway Priority

- Cancel Queue Override when mainline speed is less than the Critical Speed (CRSPEED) set at address $09C:



  - If Queue Overrides have not been activated: they won't be turned ON
  - When queue canceled, the meter goes back to normal rate

SATMS-3
Q-Overrides – Rate Hierarchy

- Highest Level 1: Field Manual

- Q2 or Super Q1-Override
  - 2nd Level : SWARM rate
  - 3rd : PSO
  - 4th : CORM
- Q1-Override
  - 5th : Traffic Responsive Rate
  - 6th : T.O.D. Rate

SATMS-3
Safety Enhancements

Safety Enhancement	SATMS-3	Vs	SATMS-1
Load Switch Failure Detection	Yes		N/A
EMS Failure Detection	Yes		N/A
Check for appropriate values	Yes		N/A

SATMS-3
Load Switch Failure Detection

- In the absence of 120 VAC to power the EMS, Shutdown Sequence will start immediately
- All entries at $0F4 are cleared. The only way to resume metering is to reprogram $0F4
- To activate this feature, just set bit 4 of COMM2 ($0F5)
- Make sure this bit is CLEAR for normal ramp metering.

SATMS-3
EMS Failure Detection

- Light bulbs for EMS are continuously monitored during metering. Shutdown sequence will start immediately upon detection of bulb failure
  - To monitor Top part of EMS, set bit 7 of $0F5
  - To monitor Bottom part of EMS, set bit 8 of $0F5
- All entries at $0F4 are cleared. The only way to resume metering is to reprogram $0F4

SATMS-3
Other Enhancements

Enhancements	SATMS-3 Vs SATMS-1	
Communication Failure (CF) during SWARM	5 minutes extension of SWARM rate	Immediate reversion to TOD rate
Magnetometer Demand Loop Lock-On	Capable to fix this problem	N/A
Minimum Green	Settable	Fixed at 2.0 second
T.O.D table	16 interval	64 interval
Holiday table	8 holidays	16 holidays
LEDs used to indicate signal head color	Yes	No

SATMS-3
Magnetometer Demand Loop

- Problem 1: Magnetometers sometimes provide only a ‘spike’ reading when a vehicle is present
- Problem 2: Magnetometers also may provide a continuous reading or ‘lock up’ high

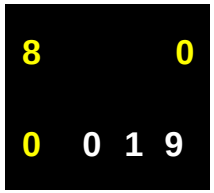
- SATMS-3 can help solve these two problems by setting bit 5 of COMM1 ($0F4)

SATMS-3
L.E.D. Display

LED	Signal Color
2	Last Green
3	Yellow
4	Green
5	Red
7	First Green

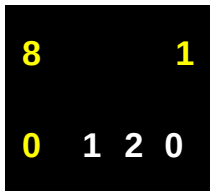
SATMS-3
Ram Map – Column 8

CTRL-ID



ID Confirmation.
This no. must be matched with actual controler ID set at the DIP switch

FIRGR



FIRST GREEN
The very First Green after Black.
60 sec min; 255 sec. Max

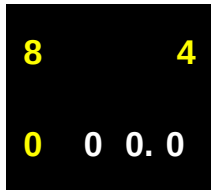
PLTYEL

Platoon Yellow
The yellow that precedes RED whenever the Vehicles/Green (PSEL) is 2 or more.
1.0 sec min; 6.0 sec max

LNGYEL

LONG YELLOW
The safety yellow whenever GREEN time is more than 7 sec.
3.0 sec min; 6.0 sec max

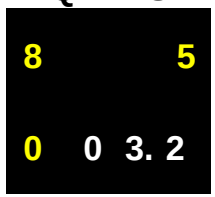
FYELL



FIRST YELLOW
The very first Yellow after First Green

Ignored in this version

QTHRS

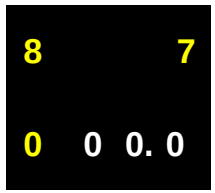


Q1 THRESHOLD
The threshold level for Q1 to be activiated

MXGRNA

MAXIMUM GREEN A
The maximum time for Green under plan 'A'

MXGRNB



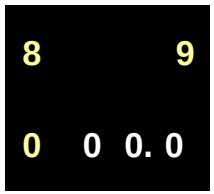
MAXIMUM GREEN B
The maximum time for Green under plan 'B'

SATMS-3
Ram Map – Column 8 (cont'd)

CROCCA

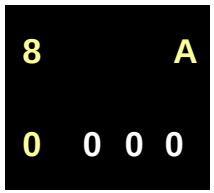
CRITICAL OCC. A (%)
Used for Traffic Responsive Metering.

CROCCB



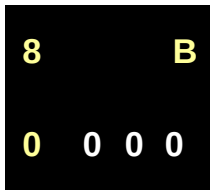
CRITICAL OCC. B (%)
Used for Traffic Responsive Metering

CRVOLA



CRITICAL VOLUME A
Used for Traffic Responsive Metering

CRVOLB

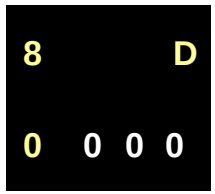


CRITICAL VOLUME B
Used for Traffic Responsive Metering

PSELA

PLATOON SELECT A
The number of vehicle per green cycle for plan 'A'

PSELB



PLATOON SELECT B
The number of vehicle per green cycle for plan 'B'

RLANES

RAMP LANES
The number of metering lane

GRNHLD

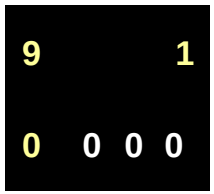
GREEN HOLD
The minimum green time for Rest-In-Green Queue 2 override, etc

SATMS-3
Ram Map – Column 9

FMNL

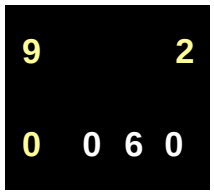
FIELD MANUAL RATE
255 - Rate not activated
000 - Black Ball indefinitely
001 - Green Ball indefinitely

FLSHR



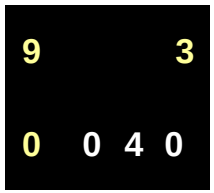
FLASING RED
A value > 0 will flash the red

LASTGR



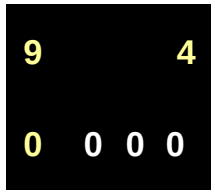
LAST GREEN
The last green time before turning the meter to black, or T.R. Rest-in-Black. User input in second

PHYSML



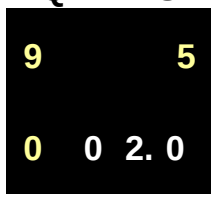
PHYSICAL MAINLINES
The number of physical mainlanes.

PHYSOP



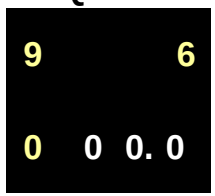
PHYSICAL OPPOSITE SIDES
The number of opposite side mainlanes.

Q2THRS



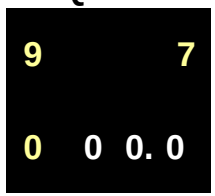
Q2 THRESHOLD
The threshold level for Q2 to be activiated

Q1ON



QUEUE 1 ON DELAY
Queue 1 override is delayed up to 25.5 sec. User input in 10ths of a second

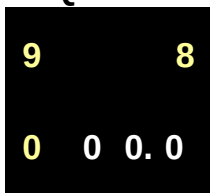
Q2ON



QUEUE 2 ON DELAY
Queue 1 override is delayed up to 25.5 sec. User input in 10ths of a second

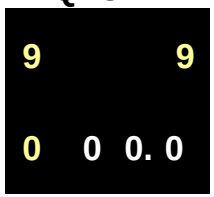
SATMS-3
Ram Map – Column 9 (cont'd)

Q1OFF

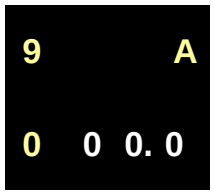


QUEUE 1 OFF DELAY
Release of queue 1 override is delayed up to 25.5 sec. User input in 10ths of a second

Q2OFF



QUEUE 2 OFF DELAY
Release of queue 1 override is delayed up to 25.5 sec. User input in 10ths of a second



(not used)

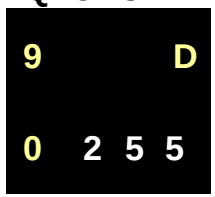
MINGRN

MINIMUM GREEN
The minimum time for Green. User input in 10th of a second.

CRSPEED

CRITICAL SPEED (MPH)
Mainline speed less than this will terminate all Queue Overrides

Q1CYGRN

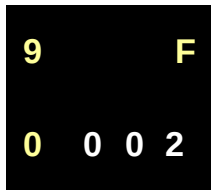


Q1 GREEN CYCLE
The number of 30-seconds cycle after Q1 reach its maximum rate, for Q1 to go green ball

Q1MAXSET

Q1 MAXIMUM RATE SET
The desired value of maximum Q1 rate, must be smaller than the maximum allowed by the program

RATESTP



RATE STEP
The number of veh/min increased by Queue 1 override

SATMS-3
Column 'F'

0F1		**0F6**	**0F8**
0 0	1 Enable Device 1	1 X Main Line 1	1 X Demand
	2 Enable Device 2	2 X Main Line 2	2 X Passage
		0 F 3 X Main Line 3	0 7 3 X Queue 1
0F4		4 X Main Line 4	4 ON1
	1 Enable Metering	5 Main Line 5	5 OFF1
	2 Enable Local Responsive	6 Main Line 6	6 Ramp HOV
0 0	3 Enable Q1 Override	7 ML HOV Flag	7 CD1
	4 Enable Q2 or Super Q1 Override	8 Fwy Conn Flag	8 CD ON
	5 Enable Independent Q2		
	6 Check ML Speed Before Q-override		
	7 Enable Mag. D & P Lock-in		
0F5		**0F7**	**0F9**
	1 Device 1 Flash	1 Opp Side 1	1 SD1
	2 Device 2 Flash	2 Opp Side 2	2 SD2
0 4	3 X "Meter On" Sign Flash	0 0 3 Opp Side 3	# 0 3 SD3
	4 Enable Load Switch Monitoring	4 Opp Side 4	4 SD4
	5 Pre-time Red (if no Demand Det)	5 Opp Side 5	5 SD5
	6 Pre-time Green (if no Passage Det)	6 Opp Side 6	6 X Queue 2
	7 Enable Shutdown Top EMS Failure	7 CD2	7 Pass Vol Count
	8 Enable Shutdown Bot. EMS Failure	8 CD OFF	8 (Not Used)

SATMS-3
Base Display

Top Left Segment

- **0** No queues activated
- **1** Q1 is activated
- **2** Q2 is activated
- **3** Both Q1 and Q2 are activated
- **4** Green Hold is is effect
- **F** False state: Q2 is activated without Q1 activated first

SATMS-3
Base Display

Top Right Segment

- **b** Metering is disabled
- **1** Field Manual Rate is in effect
- **2** SWARM rate is in effect
- **5** TRRATE is in effect
- **6** TODRATE is in effect
- **A** Today is Holiday: No metering

SATMS-3
Base Display

Bottom Left Segment

- **A** Normal display
- **b** Metering shutdown due to bad load switch
- **C** Warning: current rate is too small
- **d** Metering shutdown due to ‘Prepare To Stop’ EMS fails
- **E** Metering shutdown due to ‘Meter On’ EMS fails

SATMS-3
Base Display

Bottom Right Segments

xxx Metering Rate
000 Metering is OFF
001 Meter is Rest-in-Green

SATMS-3
Wiring Diagram